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# Correlation between Allergic Rhinitis and History of Infantile Atopic Dermatitis

**Mutiara Arikah Balqis[1], Zahrah Hikmah[2], Diah Mira Indramaya[3], Damayanti[3]**

[1]*Faculty of Medicine, University of Airlangga, Surabaya – Indonesia*

[2]*Department of Pediatric, Faculty of Medicine, University of Airlangga/Dr. Soetomo General Academic Hospital, Surabaya – Indonesia*

[3]*Department of Dermatology Venereology and Esthetic, Dr. Soetomo General Academic Hospital, Surabaya – Indoneisa, Indonesia*

**ABSTRACT**

**Background:** Atopic march is one of the global health problems that is commonly found in children. The prevalence of allergic rhinitis in Indonesia reaches to 1.5% to 12.4% and continues to increase every year. Allergic reactions can affect all tissues and organs in the body. Some clinical manifestations of allergies are allergic rhinitis, atopic dermatitis, and asthma (atopic march). Atopic march often begins in infancy with the development of atopic dermatitis later in life. **Purpose:** To analyze the correlation between the prevalence of allergic rhinitis and history of infantile atopic dermatitis in children. **Methods:** This research used an observational analytic design with a cross-sectional approach. **Result:** The data were categorized based on a history of atopic dermatitis and the diagnosis of allergic rhinitis. The statistical tests revealed a relationship between the incidence of allergic rhinitis and history of infantile AD in children. The chi-square test yielded a p-value of 0.014 and a contingency coefficient value of 0.213. The odd ratio (OR) value at a confidence level (CL) of 95% and a limit of 1.312 – 6.256 is 2.865, which means that patients who have a history of AD have a 2.8 times higher risk of experiencing AR. **Conclusion:** The conclusion of this study is that there is a correlation between the incidence of allergic rhinitis and history of infantile atopic dermatitis.

**Keywords***:* Allergic rhinitis, atopic dermatitis, atopic march, children.

Correspondence*:* Zahrah Hikmah, Department of Pediatric, Faculty of Medicine, University of Airlangga – Dr. Soetomo Surabaya General Hospital, Jl. Mayjend Prof. Dr. Moestopo No. 6-8, Surabaya, East Java 60286, Indonesia. Phone: +62 8175150-973, Email: drzahrahhikmah@gmail.com.

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## BACKGROUND

Allergic rhinitis (AR) is a chronic disease with symptoms of itchy nose, sneezing, rhinorrhea, and nasal congestion, sometimes accompanied by watery eyes, itching, and redness. The prevalence of AR in children aged 6-7 years and 13-14 years in 56 countries is around 25%.[1] Anamnesis, physical examination, and supporting exams like the skin prick test (SPT) can establish the diagnosis of AR.[2]

Allergic reactions are responses that activate a number of immune mechanisms as a signal to produce various kinds of proinflammation. Allergens that attach to IgE on a cell surface cause allergies, a type I hypersensitivity reaction. Allergic reactions can affect all tissues and organs in the body. It does not preclude other allergic diseases. Some clinical manifestations of allergic reactions are allergic rhinitis, atopic dermatitis, and asthma (atopic march).[3]

Eczema, also known as atopic dermatitis (AD), is one of the world's most common health problems in children. Generally, children with AD have a family history of the same complaint.[4] AD is initially found during infancy or childhood and improves then disappears with age.[5,6]

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Some comorbidities such as AD are commonly accompanied by AR. ISAAC, the International Study of Asthma and Allergies in Childhood Phase III, examined the prevalence of asthma, rhinoconjunctivitis, and eczema in 98 countries. In children aged 6-7 years, 0.3% of children had symptoms of rhinoconjunctivitis and eczema, and 0.9% in children aged 13-14 years.[7] The prevalence of AD in Indonesia, according to the Indonesian Pediatric Dermatology Study Group (KSDAI), is 23.67%; AD ranks first among the top 10 skin diseases in children.

The severity of AD influences the relationship between respiratory allergies and AD.[8] Studies conducted by Chiu (2020) found the development of allergic airway diseases, such as asthma and rhinitis during childhood was strongly associated with a history of early-onset AD.[9,10,11]

Therefore, this study aims to establish a correlation between the incidence of AR and the history of infantile AD experienced by children, based on the explanation of the medical problems mentioned above. This study also aimed to investigate the frequency of AR incidence in children with a history of infantile AD at the Pediatric Clinic of Dr. Soetomo Surabaya General Hospital. This study can provide valuable information to the community, aiming to prevent the occurrence of AR or other atopic march diseases by focusing on and treating AD.

## METHODS

This study used an observational analytic research design with a cross-sectional approach. The population in this study were allergic pediatric patients in the Allergy-Immunology Division Pediatric Clinic of Dr. Soetomo Surabaya General Hospital. This study used a consecutive sampling technique. The minimum sample size for this study was determined using Lemeshow's formula, which is:

$$n = \left[\frac{Z_{1-a/2}\sqrt{2P(1-P)} + Z_{1-b}\sqrt{P_1(1-P_1)+P_2(1-P_2)}}{(P1-P2)}\right]^2$$

Given:

n = Sample size

$Z_{1-a/2}$ = Z value at 95% confidence = 1.96

$Z_{1-b}$ = Z value at 80% test power = 0.84

P = $\frac{P1+P2}{2} = 0.235$

P1 = Proportion of AR with a history of AD, 33% (Ballardini, 2014) = 0.33

P2 = Proportion of AR without a history of AD, 14% (Ballardini, 2014) = 0.14

$$n = \left[\frac{1{,}96\sqrt{2x0{,}235x0{,}765} + 0{,}84\sqrt{0{,}33x0{,}67 + 0{,}14x0{,}86}}{0{,}33 - 0{,}14}\right]^2$$

$n = 77$

The sample size formula yielded a total of 77 samples. This study was to compare the incidence of AR in groups of children with and without a history of infantile AD. Therefore, to obtain a representative sample size for both groups, the sample size is multiplied by a factor of 2, resulting in a minimum total sample size of 154 people.

The inclusion criteria in this study were patients aged ≥3 years, and their parents were willing to take part in it. The study collected data from November 2023 to March 2024. This study found 155 patients who met the inclusion criteria.

Interviews and questionnaires provide the primary data. This study used the William criteria to collect primary data on the history of AD in children. The study gathers secondary data from medical records, encompassing basic information, anamnesis, diagnosis, and examination. In order to pinpoint the root causes of allergies, this study also scrutinized the SPT results obtained from patients' medical records.

The data were analyzed in Statistical Package for Social Sciences (SPSS) version 29 with the Chi-square test to determine the relationship between two variables. In a Chi-square test, if $p<0.05$, it indicates that there is a statistically significant relationship between the two variables. This study has received review and approval from the Ethics Committee at Dr. Soetomo Surabaya General Hospital (0810/KEPK/X/2023).

## RESULT

We categorize the respondents' characteristics based on their age, gender, AR diagnosis, and history of AD. In terms of age, 80 people (51.6%) in this study fell into the 6-11 years age group. The age group 0-5 years came next, comprising 64 individuals (41.3%), and the age group 12-16 years had the smallest number of respondents, with 11 individuals (7.1%). According to gender, the majority of respondents were male, with 87 people (56.1%), while 68 people (43.9%) were female. Among 155 patients, the number of patients who had a history of AD is 43 people (27.7%) and the number of AR patients is 21 people (13.5%). This study found that 109 people (70.3%) had a family history of atopy, while 46 people (29.7%) did not have family history of atopy (Table 1).

**Table 1.** The demographic characteristics of the respondents

| Characteristics | Frequency (%) |
|---|---|
| Age group (years old) | |
| 0-5 | 64 (41.3) |
| 6-11 | 80 (51.6) |
| 12-16 | 11 (7.1) |
| Sex | |
| Male | 87 (56,1) |
| Female | 68 (43.9) |
| Incidence of AR | |
| Yes | 21 (13.5) |
| No | 134 (86.5) |
| History of AD | |
| Yes | 43 (27.7) |
| No | 112 (72.3) |
| Family history of atopy | |
| Yes | 109 (70.3) |
| No | 46 (29.7) |
| Total | 155 (100) |

AR: allergic rhinitis
AD: atopic dermatitis

**Table 2.** The correlation between allergen exposure and allergic rhinitis

| | Allergic Rhinitis | | Total | *p* value | OR 95% Cl (Lower–Upper) |
|---|---|---|---|---|---|
| | Yes n (%) | No n (%) | | | |
| HDM | | | | | |
| Positive | 11 (52.4) | 30 (22.4) | 41 (100) | 0.009* | 2.340 |
| Negative | 10 (47.6) | 104 (77.6) | 114 (100) | | |
| Pet dander | | | | | |
| Positive | 1 (4.8) | 5 (3.7) | 6 (100) | 1.000 | 1.276 |
| Negative | 20 (95.2) | 129 (96.3) | 149 (100) | | |
| Food | | | | | |
| Positive | | | | | |
| Negative | 6 (28.6) | 26 (19.4) | 32 (100) | 0.500 | 1.473 |
| | 15 (71.4) | 108 (80.6) | 123 (100) | | |
| Total | 21 (100) | 134 (100) | 155 (100) | | |

*Significant if $p<0.05$
HDM: house dust mites

Table 2 shows the distribution of allergen types experienced by respondents. 11 people (52.4%) exhibited a tendency to be allergic to house dust mites (HDM), while 10 people (4.7%) did not show this tendency. Then, 2 individuals (9.5%) exhibited a tendency to be allergic to pet dander, a condition that was not detected in 19 people (90.5%). Furthermore, we discovered that 6 individuals (28.6%) exhibited a tendency to have food allergies, this was absent in 15 people (71.4%).

**Table 3.** The results of the skin prick test on children with a history of atopic dermatits

| Variable | History of AD | | Total |
|---|---|---|---|
| | Yes n (%) | No n (%) | |
| HDM | | | |
| Positive | 40 (93.0) | 1 (0.9) | 41 (100) |
| Negative | 3 (7.0) | 111 (99.1) | 114 (100) |
| Pet dander | | | |
| Positive | 6 (14.0) | 0 (0) | 6 (100) |
| Negative | 37 (86.0) | 112 (100) | 149 (100) |
| Food | | | |
| Positive | 30 (69.8) | 2 (1.8) | 32 (100) |
| Negative | 13 (30.2) | 110 (98.2) | 123 (100) |
| Total | 43 (100) | 112 (100) | 155 (100) |

HDM: house dust mites
AD: atopic dermatitis

Table 3 shows the distribution of allergen types experienced by respondents. 40 people (95.3%) showed a tendency to be allergic to HDM, while 3 people (4.7%) showed no such tendency. Then, 9 people (20.9%) exhibited a tendency to be allergic to pet dander, while 34 people (79.1%) did not show this tendency. Additionally, 32 people (74.4%) showed a tendency to be allergic to food, while 11 people (25.6%) did not show this tendency.

**Table 4**. The correlation between allergic rhinitis and a history of infantile atopic dermatitis

| History of AD | AR | | Total | *p* value | OR 95% Cl (Lower–Upper) |
|---|---|---|---|---|---|
| | Yes n (%) | No n (%) | | | |
| Yes | 11 (25.6) | 32 (74.4) | 43 (100) | | |
| No | 10 (8.9) | 102 (91.1) | 112 (100) | 0,014* | 2,865 (1,312 – 6,256) |
| Total | 21 (100) | 134 (100) | 155 (100) | | |

*Significant if $p<0.05$
AR: allergic rhinitis
AD: atopic dermatitis

Based on Table 4, the number of AR patients who have a history of AD is 11 people (25.6%), while the number of patients who did not have a history of AD is 32 people (74.4%). Patients who did not have a history of AD with AR were 10 people (8.9%), while patients who did not have a history of AD with no AR were 102 people (91.1%). The chi-square test yielded a p-value of 0.014, indicating a significant correlation between the history of AD and the incidence of AR. The odd ratio (OR) value at a confidence level (CL) of 95% and a limit of 1.312 - 6.256 is 2.865, which means that patients who have a history of AD have a 2.8 times higher risk of experiencing AR.

## DISCUSSION

Table 1 displays the gender characteristics of respondents, revealing that males (66.7%) make up the majority of AR patients, while females (33.3%) make up the minority. Research by Nurhalizah (2023) and Ho (2021) indicates that AR primarily impacts boys. [12,13,14]

AR can occur due to genetic and environmental factors. According to Nurhalizah (2023), the incidence of AR in males is higher than in females, but as age increases towards adolescence, females with AR are actually more numerous, so gender factors are not associated with the risk of AR.[12] The effects of puberty are likely to influence this, according to Ho (2021). Hormonal differences between males and females can affect their immune systems. Hormonal differences between males and females can affect their immune system.[15,16]

Table 1 of this study indicates that the age group of 6-11 years accounted for the majority of children with AR. Zhao (2010) found that the age group of 6-11 years has the highest prevalence of children with AR.[17] Rahma (2022) conducted a study that examined the differences in the function and structure of the skin barrier from birth to adulthood, explaining that the epidermal barrier has poor function in infants but will improve with age.[6,18]

The results of bivariate analysis research using the chi-square test, as shown in Table 4, indicate a relationship between the incidence of AR and the history of infantile AD in children. The *p*-value obtained was 0.014. This study yielded a contingency coefficient value of 0.213. This study also reveals that children with a history of AD are at a 2.865-fold increased risk of developing AR.

AD is a condition that causes skin barrier dysfunction. Skin barrier dysfunction is caused by repeated sensitization from exposure to allergens on the skin. Early environmental allergen sensitization in

infantile AD children leads to epidermal barrier dysfunction, increasing their susceptibility to allergen penetration.[19] This sensitization can trigger the development of other allergic diseases, such as AR. This supports the atopic march theory, which is the course of allergic disease that begins with the appearance of AD as an infant, followed by the onset of rhinitis and also asthma from childhood to adolescence.[9,10]

Table 2 shows the results of the chi-square test analysis of the type of allergen exposure and the incidence of AR. It is known that HDM has a significant relationship with the occurrence of AR, namely getting a *p*-value of 0.009 ($p<0.05$). Indoor air pollution such as HDM, secondhand smoke, and pet dander, can significantly increase the incidence of AR in children.[20] HDM sensitization was associated with a significantly increased risk of AD, AR, and asthma. The home environment influences the growth of allergens such as mold and HDM. Homes with poor ventilation also tend to have higher levels of indoor pollutants, which can exacerbate allergic conditions in children.[21,22]

House dust mite allergy (HDM) is a type I hypersensitivity reaction mediated by IgE. Allergens originating from mite feces or bodies enter the body through the airway or skin, triggering an excessive immune response. In AD patients, the damaged epidermal barrier allows allergens to penetrate the skin more easily, triggering an immune response and producing HDM-specific IgE.[23]

Table 1 shows the majority of respondents in this study had a family history of atopy. Children who have a family history of atopy tend to have a higher risk of developing AR.[14] Mutations in the FLG gene, which alter the function of skin barrier formation and maintenance, significantly influence the development of AD and increase the risk of AR sensitization. This disrupted skin barrier allows allergens and irritants to penetrate the skin more easily, triggering an excessive immune response and causing other allergic diseases, such as AR.[20]

Other genes, such as Toll like receptor (TLR) TLR2 and TLR4, which contribute to pathogen recognition and immune response regulation, are also associated with the progression of AD to AR. Variations in these genes may influence the body to respond to allergen exposure.[24]

Early identification and management of risk factors are necessary to reduce the impact of AR in children. Interventions such as minimizing exposure to allergens at home, keeping the environment clean, and treating AD can be effective in reducing symptoms. This preventive approach not only helps reduce the frequency and severity of AD symptoms but also has the potential to prevent the development of other allergic conditions, such as asthma and AR.[22]

The Allergy-Immunology Division of the Pediatric Clinic at Dr. Soetomo Surabaya General Hospital conducted research that concluded a significant correlation between the incidence of AR and a history of infantile AD in children. It also can be concluded that, there is a significant correlation between HDM allergy and AR in children.

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